

What is claimed is:

1 1. An imager, comprising:
2 a two-dimensional array of photosensors, each photosensor having a center point;
3 and
4 a two-dimensional array of microlenses positioned over said two-dimensional
5 array of photosensors, each microlens being associated with a corresponding photosensor,
6 each microlens having a center point;
7 said microlens being positioned over said corresponding photosensor such that a
8 center point of a microlens is offset, in a first direction, from a center point of a
9 corresponding photosensor.

1 2. The imager as claimed in claim 1, wherein said microlens is positioned over
2 said corresponding photosensor such that said center point of said microlens is offset, in a
3 second direction, from said center point of said corresponding photosensor, said first
4 direction being orthogonal to said second direction.

1 3. The imager as claimed in claim 1, wherein said first direction is radial with
2 respect to a central point on a plane of said two-dimensional array of photosensors.

1 4. The imager as claimed in claim 1, wherein said microlenses are positioned
2 over said corresponding photosensors such that a center point of each microlenses is
3 offset from a center point of a corresponding photosensor, each offset having an amount
4 and a direction such that said amounts and directions spatially vary across said two-
5 dimensional array of photosensors.

1 5. The imager as claimed in claim 1, wherein said offset is spatially varying.

1 6. The imager as claimed in claim 1, further comprising:
2 a color filter array positioned over said two-dimensional array of photosensors.

1 7. The imager as claimed in claim 6, wherein said color filter array comprises a
2 plurality of color filter areas, each color filter area being associated with a corresponding
3 photosensor and having a center point;

4 said color filter area being positioned over said corresponding photosensor such
5 that a center point of a color filter area is offset, in a first direction, from a center point of
6 a corresponding photosensor.

1 8. The imager as claimed in claim 7, wherein said color filter area is positioned
2 over said corresponding photosensor such that said center point of said color filter area is
3 offset, in a second direction, from said center point of said corresponding photosensor,
4 said first direction being orthogonal to said second direction.

1 9. The imager as claimed in claim 7, wherein said color filter areas are positioned
2 over said corresponding photosensors such that a center point of each color filter area is
3 offset from a center point of a corresponding photosensor, each offset having an amount
4 and a direction such that said amounts and directions spatially vary across said two-
5 dimensional array of photosensors.

1 10. The imager as claimed in claim 7, wherein said first direction corresponding
2 to said color filter area offset is radial with respect to a central point on a plane of said
3 two-dimensional array of photosensors.

1 11. The imager as claimed in claim 7, wherein said color filter area offset is
2 spatially varying.

1 12. The imager as claimed in claim 1, further comprising:
2 a layer of transmissive apertures positioned over said two-dimensional array of
3 photosensors, each aperture being associated with a corresponding photosensor and
4 having a center point.

1 13. The imager as claimed in claim 12, wherein said aperture is positioned over
2 said corresponding photosensor such that a center point of an aperture is offset, in a first
3 direction, from a center point of a corresponding photosensor.

1 14. The imager as claimed in claim 13, wherein said aperture is positioned over
2 said corresponding photosensor such that said center point of said aperture is offset, in a
3 second direction, from said center point of said corresponding photosensor, said first
4 direction being orthogonal to said second direction.

1 15. The imager as claimed in claim 12, wherein said apertures are positioned over
2 said corresponding photosensors such that a center point of each aperture is offset from a
3 center point of a corresponding photosensor, each offset having an amount and a
4 direction such that said amounts and directions spatially vary across said two-
5 dimensional array of photosensors.

1 16. The imager as claimed in claim 12, wherein said first direction corresponding
2 to said aperture offset is radial with respect to a central point on a plane of said two-
3 dimensional array of photosensors.

1 17. The imager as claimed in claim 12, wherein said aperture offset is spatially
2 varying.

1 18. The imager as claimed in claim 12, wherein said layer of transmissive
2 apertures is a metal layer of apertures such that the metal layer blocks stray radiation and
3 the apertures allow radiation to pass therethrough.

1 19. An imager, comprising:
2 a two-dimensional array of photosensors, each photosensor having a center point;
3 and
4 a color filter array positioned over said two-dimensional array of photosensors,
5 said color filter array including a plurality of color filter areas, each color filter area being
6 associated with a corresponding photosensor and having a center point;
7 said color filter area being positioned over a corresponding photosensor such that
8 a center point of a color filter area is offset, in a first direction, from a center point of a
9 corresponding photosensor.

1 20. The imager as claimed in claim 19, wherein said color filter area is positioned
2 over said corresponding photosensor such that said center point of said color filter area is
3 offset, in a second direction, from said center point of said corresponding photosensor,
4 said first direction being orthogonal to said second direction.

1 21. The imager as claimed in claim 19, wherein said color filter areas are
2 positioned over said corresponding photosensors such that a center point of each color
3 filter area is offset from a center point of a corresponding photosensor, each offset having
4 an amount and a direction such that said amounts and directions spatially vary across said
5 two-dimensional array of photosensors.

1 22. The imager as claimed in claim 19, wherein said first direction corresponding
2 to said color filter area offset is radial with respect to a central point on a plane of said
3 two-dimensional array of photosensors.

1 23. The imager as claimed in claim 19, wherein said color filter area offset is
2 spatially varying.

1 24. The imager as claimed in claim 19, further comprising:
2 a layer of transmissive apertures positioned over said two-dimensional array of
3 photosensors, each aperture being associated with a corresponding photosensor and
4 having a center point.

1 25. The imager as claimed in claim 24, wherein said aperture is positioned over
2 said corresponding photosensor such that a center point of a aperture is offset, in a first
3 direction, from a center point of a corresponding photosensor.

1 26. The imager as claimed in claim 24, wherein said apertures are positioned over
2 said corresponding photosensors such that a center point of each aperture is offset from a
3 center point of a corresponding photosensor, each offset having an amount and a
4 direction such that said amounts and directions spatially vary across said two-
5 dimensional array of photosensors.

1 27. The imager as claimed in claim 24, wherein said first direction corresponding
2 to said aperture offset is radial with respect to a central point on a plane of said two-
3 dimensional array of photosensors.

1 28. The imager as claimed in claim 24, wherein said aperture offset is spatially
2 varying.

1 29. The imager as claimed in claim 25, wherein said aperture is positioned over
2 said corresponding photosensor such that said center point of said aperture is offset, in a
3 second direction, from said center point of said corresponding photosensor, said first
4 direction being orthogonal to said second direction.

1 30. The imager as claimed in claim 24, wherein said layer of transmissive
2 apertures is a metal layer of apertures such that the metal layer blocks stray radiation and
3 the apertures allow radiation to pass therethrough.

1 31. An imager, comprising:
2 a two-dimensional array of photosensors, each photosensor having a center point;
3 and
4 a layer of transmissive apertures positioned over said two-dimensional array of
5 photosensors, each aperture being associated with a corresponding photosensor and
6 having a center point;
7 said aperture being positioned over said corresponding photosensor such that a
8 center point of a aperture is offset, in a first direction, from a center point of a
9 corresponding photosensor.

1 32. The imager as claimed in claim 31, wherein said aperture is positioned over
2 said corresponding photosensor such that said center point of said aperture is offset, in a
3 second direction, from said center point of said corresponding photosensor, said first
4 direction being orthogonal to said second direction.

1 33. The imager as claimed in claim 31, wherein said apertures are positioned over
2 said corresponding photosensors such that a center point of each aperture is offset from a

3 center point of a corresponding photosensor, each offset having an amount and a
4 direction such that said amounts and directions spatially vary across said two-
5 dimensional array of photosensors.

1 34. The imager as claimed in claim 31, wherein said layer of transmissive
2 apertures is a metal layer of apertures such that the metal layer blocks stray radiation and
3 the apertures allow radiation to pass therethrough.

1 35. The imager as claimed in claim 31, wherein said first direction corresponding
2 to said aperture offset is radial with respect to a central point on a plane of said two-
3 dimensional array of photosensors.

1 36. The imager as claimed in claim 31, wherein said aperture offset is spatially
2 varying.

1 37. An imager, comprising:

2 a two-dimensional array of photosensors, each photosensor having a center point;

3 a two-dimensional array of microlenses positioned over said two-dimensional
4 array of photosensors, each microlens being associated with a corresponding photosensor,
5 each microlens having a center point;

6 a color filter array positioned over said two-dimensional array of photosensors,
7 said color filter array including a plurality of color filter areas, each color filter area being
8 associated with a corresponding photosensor and having a center point; and

9 a layer of transmissive apertures positioned over said two-dimensional array of
10 photosensors, each aperture being associated with a corresponding photosensor and
11 having a center point;

12 said microlens being positioned over said corresponding photosensor such that a
13 center point of a microlens is offset, in a first direction, from a center point of a
14 corresponding photosensor;

15 said color filter area being positioned over said corresponding photosensor such
16 that a center point of a color filter area is offset, in said first direction, from a center point
17 of a corresponding photosensor;

18 said aperture being positioned over said corresponding photosensor such that a
19 center point of a aperture is offset, in said first direction, from a center point of said
20 corresponding photosensor.

1 38. The imager as claimed in claim 37, wherein said microlens is positioned over
2 said corresponding photosensor such that said center point of said microlens is offset, in a
3 second direction, from said center point of said corresponding photosensor, said first
4 direction being orthogonal to said second direction;

5 said color filter area being positioned over said corresponding photosensor such
6 that said center point of said color filter area is offset, in said second direction, from said
7 center point of said corresponding photosensor;

8 said aperture being positioned over said corresponding photosensor such that said
9 center point of said aperture is offset, in said second direction, from said center point of
10 said corresponding photosensor.

1 39. The imager as claimed in claim 37, wherein said layer of transmissive
2 apertures is a metal layer of apertures such that the metal layer blocks stray radiation and
3 the apertures allow radiation to pass therethrough.

1 40. The imager as claimed in claim 37, wherein said microlenses are positioned
2 over said corresponding photosensors such that a center point of each microlenses is
3 offset from a center point of a corresponding photosensor, each offset having an amount
4 and a direction such that said amounts and directions spatially vary across said two-
5 dimensional array of photosensors;

6 said color filter areas being positioned over said corresponding photosensors such
7 that a center point of each color filter area is offset from a center point of a corresponding
8 photosensor, each offset having an amount and a direction such that said amounts and
9 directions spatially vary across said two-dimensional array of photosensors;

10 said apertures being positioned over said corresponding photosensors such that a
11 center point of each aperture is offset from a center point of a corresponding photosensor,
12 each offset having an amount and a direction such that said amounts and directions
13 spatially vary across said two-dimensional array of photosensors.

1 41. The imager as claimed in claim 37, wherein said first direction corresponding
2 to said microlens offset is radial with respect to a central point on a plane of said two-
3 dimensional array of photosensors;

4 said first direction corresponding to said color filter area offset being radial with
5 respect to a central point on a plane of said two-dimensional array of photosensors;

6 said first direction corresponding to said aperture offset being radial with respect
7 to a central point on a plane of said two-dimensional array of photosensors.

1 42. The imager as claimed in claim 37, wherein said microlens offset is spatially
2 varying;

3 said color filter area offset being spatially varying;

4 said aperture offset being spatially varying.
5

6 43. An imaging system, comprising:

7 a two-dimensional array of photosensors, each photosensor having a center point;

8 a non-telecentric lens positioned over said two-dimensional array of photosensors;

9 and

10 a two-dimensional array of microlenses positioned over said two-dimensional
11 array of photosensors, each microlens being associated with a corresponding photosensor,
12 each microlens having a center point;

13 said microlens being positioned over said corresponding photosensor such that a
14 center point of a microlens is offset from a center point of a corresponding photosensor,
15 each offset having an amount and a direction such that said amounts and directions
16 spatially vary across said two-dimensional array of photosensors;

17 said spatial variation being determined based on optical characteristics of said
18 non-telecentric lens and optical properties of said two-dimensional array of photosensors
19 and said microlenses such that light sensitivity of each pixel is maximized.

1 44. The imaging system as claimed in claim 43, further comprising:

2 a color filter array positioned over said two-dimensional array of photosensors.

1 45. The imaging system as claimed in claim 44, wherein said color filter array
2 comprises a plurality of color filter areas, each color filter area being associated with a
3 corresponding photosensor and having a center point;

4 said color filter area being positioned over said corresponding photosensor such
5 that said center point of said color filter area is offset from said center point of said
6 corresponding photosensor, each offset having an amount and a direction such that said
7 amounts and directions spatially vary across said two-dimensional array of photosensors;
8 said spatial variation being determined based on optical characteristics of said
9 non-telecentric lens and optical properties of said two-dimensional array of photosensors
10 and said color filter areas such that crosstalk is minimized.

1 46. The imaging system as claimed in claim 43, further comprising:
2 a layer of transmissive apertures positioned over said two-dimensional array of
3 photosensors, each aperture being associated with a corresponding photosensor and
4 having a center point.

1 47. The imaging system as claimed in claim 46, wherein said aperture is
2 positioned over said corresponding photosensor such that said center point of said
3 aperture is offset from said center point of said corresponding photosensor, each offset
4 having an amount and a direction such that said amounts and directions spatially vary
5 across said two-dimensional array of photosensors;

6 said spatial variation being determined based on optical characteristics of said
7 non-telecentric lens and optical properties of said two-dimensional array of photosensors
8 and said apertures such that stray light signals are minimized.

1 48. The imaging system as claimed in claim 46, wherein said layer of
2 transmissive apertures is a metal layer of apertures such that the metal layer blocks stray
3 radiation and the apertures allow radiation to pass therethrough.

1 49. An imaging system, comprising:
2 a two-dimensional array of photosensors, each photosensor having a center point;

3 a non-telecentric lens positioned over said two-dimensional array of photosensors;
4 and
5 a color filter array positioned over said two-dimensional array of photosensors,
6 said color filter array including a plurality of color filter areas, each color filter area being
7 associated with a corresponding photosensor and having a center point;
8 said color filter area being positioned over said corresponding photosensor such
9 that said center point of said color filter area is offset from said center point of said
10 corresponding photosensor, each offset having an amount and a direction such that said
11 amounts and directions spatially vary across said two-dimensional array of photosensors;
12 said spatial variation being determined based on optical characteristics of said
13 non-telecentric lens and optical properties of said two-dimensional array of photosensors
14 and said color filter areas such that crosstalk is minimized.

1 50. The imaging system as claimed in claim 49, further comprising:
2 a layer of transmissive apertures positioned over said two-dimensional array of
3 photosensors, each aperture being associated with a corresponding photosensor and
4 having a center point.

1 51. The imaging system as claimed in claim 50, wherein said aperture is
2 positioned over said corresponding photosensor such that said center point of said
3 aperture is offset from said center point of said corresponding photosensor, each offset
4 having an amount and a direction such that said amounts and directions spatially vary
5 across said two-dimensional array of photosensors;
6 said spatial variation being determined based on optical characteristics of said
7 non-telecentric lens and optical properties of said two-dimensional array of photosensors
8 and said apertures such that stray light signals are minimized.

1 52. The imaging system as claimed in claim 50, wherein said layer of
2 transmissive apertures is a metal layer of apertures such that the metal layer blocks stray
3 radiation and the apertures allow radiation to pass therethrough.

1 53. An imaging system, comprising:
2 a two-dimensional array of photosensors, each photosensor having a center point;

3 a non-telecentric lens positioned over said two-dimensional array of photosensors;
4 and
5 a layer of transmissive apertures positioned over said two-dimensional array of
6 photosensors, each aperture being associated with a corresponding photosensor and
7 having a center point;
8 said aperture being positioned over said corresponding photosensor such that said
9 center point of said aperture is offset from said center point of said corresponding
10 photosensor, each offset having an amount and a direction such that said amounts and
11 directions spatially vary across said two-dimensional array of photosensors;
12 said spatial variation being determined based on optical characteristics of said
13 non-telecentric lens and optical properties of said two-dimensional array of photosensors
14 and said apertures such that stray light signals are minimized.

1 54. An imaging system, comprising:
2 a two-dimensional array of photosensors, each photosensor having a center point;
3 a non-telecentric lens positioned over said two-dimensional array of photosensors;
4 a two-dimensional array of microlenses positioned over said two-dimensional
5 array of photosensors, each microlens being associated with a corresponding photosensor,
6 each microlens having a center point;
7 a color filter array positioned over said two-dimensional array of photosensors,
8 said color filter array including a plurality of color filter areas, each color filter area being
9 associated with a corresponding photosensor and having a center point; and
10 a layer of transmissive apertures positioned over said two-dimensional array of
11 photosensors, each aperture being associated with a corresponding photosensor and
12 having a center point;
13 said microlens being positioned over said corresponding photosensor such that
14 said center point of said microlens is offset from said center point of said corresponding
15 photosensor, each microlens offset having an amount and a direction such that said
16 amounts and directions spatially vary across said two-dimensional array of photosensors;
17 said color filter area being positioned over said corresponding photosensor such
18 that said center point of said color filter area is offset from said center point of said

19 corresponding photosensor, each color filter area offset having an amount and a direction
20 such that said amounts and directions spatially vary across said two-dimensional array of
21 photosensors;

22 said aperture being positioned over said corresponding photosensor such that said
23 center point of said aperture is offset, in said first direction, from said center point of said
24 corresponding photosensor, each aperture offset having an amount and a direction such
25 that said amounts and directions spatially vary across said two-dimensional array of
26 photosensors;

27 said spatial variation of said microlens offsets being determined based on optical
28 characteristics of said non-telecentric lens and optical properties of said two-dimensional
29 array of photosensors and said microlenses such that light sensitivity of each pixel is
30 maximized;

31 said spatial variation of said color filter area offsets being determined based on
32 optical characteristics of said non-telecentric lens and optical properties of said two-
33 dimensional array of photosensors and said color filter areas such that crosstalk is
34 minimized;

35 said spatial variation of said aperture offsets being determined based on optical
36 characteristics of said non-telecentric lens and optical properties of said two-dimensional
37 array of photosensors and said apertures such that stray light signals are minimized.